



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

APPENDIX, No. III.

RESULTS of METEOROLOGICAL INQUIRIES, made at MADRAS, by JOHN GOLDINGHAM, Esq., F.R.S., M.R.A.S., M.A.S. Calcutta, &c. &c.—(Communicated 16th of January 1830.)

I HAVE the honour to lay before the Society some results of meteorological inquiries made at Madras, between the years 1796 and 1826. The observatory, where the barometer and the other instruments used were placed, was two miles and three-quarters distant from the sea, and about twenty feet above its level. It was known that the barometer in settled weather in India had a continued regular rise and fall in the twenty-four hours, and that the times of its greatest and least heights were nearly the same on different days; but I did not recollect that any observations upon a very extended scale had been made with the view of exhibiting such changes: in order therefore to obtain the quantities and times of these diurnal variations, I had the height of the barometer taken every hour during three days of each month in the year 1823. These observations are given in detail in the table beginning at page 374 of the volume of “Madras Observatory Papers.”

The rise and fall of the barometer were very regular in the twenty-four hours during the year; at about ten o'clock in the forenoon it was at its greatest height; it then began to fall, and continued falling until a little after five in the afternoon, when it was lowest; it then commenced rising, and before eleven at night attained its highest point; and was again lowest at four o'clock in the morning. Any change of wind or weather, of course, will break this chain of regularity, more or less according to the suddenness or violence of the change; but as there were no great or sudden changes at Madras in the twenty-four hours during the year 1823, the regularity is not much broken, scarcely at all indeed in the forenoon, but more at other times.

The following abstract, made from the hourly diary, shews the times of the greatest and least heights of the barometer in twenty-four hours: I have divided this into two equal intervals of six months, in order to shew what difference there would be between the means of each interval.

Times of the Greatest and Least Heights of the Barometer in Twenty-four Hours the First Six Months of the Year 1823.

		Forenoon.	Afternoon.	Night.	Morning.
{ 1824 1823 }		Greatest.	Least.	Greatest.	Least.
Jan.	10	11 h.	4 h.	13 h.	3½ h.
—	20	10	5	9½	3
—	28	10½	5	10	3
Feb.	10	10	4	10	4
—	20	10	7	11	4½
—	28	10	4	9	5
Mar.	10	10	7	13	3
—	20	10	5½	10	4
—	30	10	6	11	5
April	10	10	6	10	5
—	20	10	5½	10	4
—	30	10	5	13	3
May	10	10	4	11	4
—	20	10	5	10	2
—	30	10	7	11	4
June	10	10	5	11	3
—	20	10	6	12	4
—	30	10	5	10	5
Mean		10·10	5·33	10·8	3·83

Times of the Greatest and Least Heights of the Barometer in Twenty-four Hours the Last Six Months of the Year 1823.

		Forenoon.	Afternoon.	Night.	Morning.
$\left. \begin{matrix} 1824 \\ 1823 \end{matrix} \right\}$		Greatest.	Least.	Greatest.	Least.
July	10	10 h.	6 h.	10 h.	— h.
—	20	10	7	12	5
—	30	10	5	—	4
Aug.	10	10	6	11	$4\frac{1}{2}$
—	20	10	5	10	5
—	30	11	5	$11\frac{1}{2}$	3
Sept.	10	10	4	11	3
—	20	9	$4\frac{1}{2}$	10	4
—	30	10	6	11	5
Oct.	10	10	6	10	5
—	20	10	$5\frac{1}{2}$	10	4
—	30	11	4	10	5
Nov.	10	10	7	11	5
—	20	$10\frac{1}{2}$	5	$10\frac{1}{2}$	5
—	30	10	5	11	4
Dec.	10	10	6	11	4
—	20	10	$4\frac{1}{2}$	10	5
—	30	11	6	10	4
Mean	..	10·14	5·42	10·6	4·38
Mean first six Months }		10·10	5·33	10·8	3·83
Mean	..	10·12	5·38	10·7	4·10

If we divide the year into equal parts, the means of the intervals will be found to agree equally near with the above.

The subjoined abstract shews the variations of the Barometer in the twenty-four hours of the days of observation in the diary. This is also divided into two intervals of six months each, and the means of each interval likewise agree together in a striking manner.

Variations of the Barometer in Twenty-four Hours for the First Six Months of the Year 1823.

		From 10 A.M. to 5 P.M.	From 5 P.M. to 10 P.M.	From 10 P.M. to 4 A.M.	From 4 A.M. to 10 A.M.
{ 1824 } { 1823 }		Inches.	Inches.	Inches.	Inches.
Jan.	10	0·052	0·034	0·010	0·025
—	22	0·083	0·028	0·023	0·078
—	28	0·060	0·051	0·025	0·034
Feb.	10	0·073	0·062	0·039	0·054
—	20	0·080	0·086	0·073	0·067
—	28	0·050	0·032	0·021	0·039
Mar.	10	0·093	0·036	0·033	0·090
—	20	0·057	0·047	0·040	0·050
—	30	0·068	0·040	0·035	0·063
April	10	0·077	0·069	0·059	0·067
—	20	0·096	0·053	0·025	0·068
—	30	0·078	0·078	0·029	0·019
May	10	0·107	0·135	0·118	0·018
—	20	0·077	0·075	0·027	0·021
—	30	0·079	0·043	0·026	0·064
June	10	0·102	0·054	0·035	0·083
—	20	0·078	0·106	0·058	0·030
—	30	0·085	0·053	0·014	0·046
Mean		0·078	0·060	0·038	0·054

Variations of the Barometer in Twenty-four Hours for the Last Six Months of the Year 1823.

		From 10 A.M. to 5 P.M.	From 5 P.M. to 10 P.M.	From 10 P.M. to 4 A.M.	From 4 A.M. to 10 A.M.
{ 1824 } { 1823 }		Inches.	Inches.	Inches.	Inches.
July	10	0·088	0·010	0·002	0·080
—	20	0·110	0·093	0·038	0·055
—	30	0·065	0·070	0·010	0·005
Aug.	10	0·076	0·064	0·003	0·015
Full Moon 22d nearest ap- proach 18th.	20	0·117	0·103	0·058	0·072
—	30	0·094	0·072	0·056	0·066
Sept.	10	0·075	0·085	0·025	0·015
—	20	0·113	0·070	0·015	0·056
—	30	0·103	0·123	0·065	0·045
Oct.	10	0·085	0·075	0·036	0·046
—	20	0·065	0·065	0·025	0·025
—	30	0·054	0·072	0·078	0·060
Nov.	10	0·092	0·022	0·045	0·015
—	20	0·048	0·048	0·004	0·004
—	30	0·064	0·049	0·010	0·025
Dec.	10	0·075	0·046	0·018	0·047
—	20	0·055	0·055	0·032	0·032
—	30	0·065	0·065	0·058	0·058
Mean	..	0·080	0·066	0·032	0·040
First 6 Months		0·078	0·060	0·058	0·054
Mean of both		0·079	0·063	0·035	0·047

The barometer is generally higher at about 10 A.M. than at 11 P.M., the times before-mentioned, when it reaches its greatest height in the twenty-four hours; and it is lower at 5 P.M. than at 4 o'clock in the morning.

It hence appears that the atmosphere is acted upon by an influence constantly and regularly operating during the year; that it has its greatest density at about ten o'clock in the forenoon, diminishing till five in the afternoon, when it begins to regain what it had lost; and continues advancing towards its first state until about eleven o'clock at night, when it has nearly the same density as in the forenoon. The diminution of density again begins, and a like effect is produced by the disturbing power as in the day; the atmosphere, however, is not affected in so great a degree as when the sun is above the horizon.

As it seemed that the heights taken during the usual interval of observing meteorological instruments, generally between sun-rise and eight or nine P.M., were not those best calculated for the purpose of finding the exact mean: in order to ascertain what corrections should be applied on this account, the thermometer and hygrometer were also observed, with the barometer, every hour during the interval before stated; also the winds and weather, together with the phases of the moon for each month; the day of the nearest approach of the moon to the earth in the month; and the day of her greatest distance. These observations are also given in detail in the Madras Observatory Papers.*

In the next Table are the heights of the barometer, thermometer, and hygrometer, taken from the ordinary diary on the days when the observations in the former Table were made, that is, the 10th, 20th, and 30th of each month; with the differences of the means of both sets of observations: these differences, contained in a supplementary table, are the corrections sought, and are applied to the daily means of the heights of the diary, as usually kept; a second supplementary table contains the corrections for the monthly means, found by taking the means of the daily corrections, and are also applied to the monthly means of the diary.

Madras is upon an open coast, and the time of the high-water at the *Syzigies* appears to be at 6h. 4m., the ebb and flow about six hours each way, with a rise and fall of little more than three feet.

If the times of these tides of the atmosphere, as they may be termed, as shewn by the barometer, varied daily, like the times of the tides of the ocean, we might consider the moon as mainly instrumental in producing them; but occurring at nearly the same hours every day of the year, whatever may be the phases of the moon, or her position in her orbit, we must be contented with allowing that planet her ordinary influence.

By selecting from the diary in 1823, for every hour the circumstances regarding the height and variation of the barometer with the winds and weather, and the position of the moon in her orbit, on days when the barometer was most likely to be affected by

* Table beginning at page 374.

that luminary; also the greatest and least heights of the barometer on the same days, with the other circumstances relating to the moon, winds, and weather, in an interval of years from the common diary, we shall not be led to the conclusion, after a particular examination, that the moon has any material influence in the changes of the atmosphere here stated as shewn by the barometer: nor indeed shall we be able to conclude that her influence, like the sun's, is at any time considerable, as regards the ordinary changes and motions of the atmosphere. While the moon raises the waters of the ocean, and gives light to the earth, we should be led to conclude from such experiments, that she exerts only a steady attractive power upon the air, and that her influence as relates to the changes often attributed to it, is not by any means so great as is commonly supposed. With respect to the changes shewn by the observations here noticed, they are effected by regularly-ordained causes for the purpose of rendering the atmosphere suitable for the purposes intended, and of course for the benefit of the noble creation it surrounds; it being essential that these changes should take place in the atmosphere regularly at or near the same times every twenty-four hours, while the times of the flux and reflux of the ocean are daily changing.

The following STATEMENT shews the corrected daily Mean Height at Madras of
Years 1796

DAYS.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.	
	Barom.	Ther.	Barom.	Ther.	Barom.	Ther.	Barom.	Ther.	Barom.	Ther.	Barom.	Ther.
	Inches.	Deg.	Inches.	Deg.	Inches.	Deg.	Inches.	Deg.	Inches.	Deg.	Inches.	Deg.
1	30.105	75.43	30.104	76.25	30.046	79.93	29.990	82.88	29.920	85.18	29.834	89.01
2	30.086	74.79	30.089	76.19	30.085	80.04	29.977	82.49	29.924	85.12	29.839	88.32
3	30.197	74.80	30.092	76.22	30.067	80.55	29.986	82.71	29.931	85.62	29.838	89.04
4	30.101	75.05	30.077	76.39	30.029	80.46	29.988	82.19	29.917	85.09	29.852	88.69
5	30.098	74.62	30.079	77.11	30.025	81.04	29.976	83.02	29.903	85.90	29.852	88.74
6	30.101	74.42	30.087	77.27	20.020	80.06	29.965	83.40	29.904	86.12	29.843	88.34
7	30.117	75.23	30.074	76.81	30.033	80.53	29.986	83.34	29.910	86.55	29.836	88.28
8	30.120	74.76	30.084	77.21	30.027	80.63	29.968	83.37	29.904	86.22	29.840	88.50
9	30.112	74.59	30.077	77.26	30.066	80.87	29.963	84.23	29.865	85.78	29.852	88.33
10	30.111	74.60	30.083	77.82	30.022	80.55	29.956	83.60	29.885	86.51	29.851	88.08
11	30.127	75.09	30.106	77.68	29.981	80.50	29.965	83.60	29.885	86.37	29.850	88.41
12	30.114	74.69	30.091	77.56	30.028	80.67	29.977	83.45	29.875	86.03	29.850	88.59
13	30.116	75.07	30.082	77.49	30.035	80.60	29.964	83.60	29.873	87.22	29.870	88.15
14	30.109	74.89	30.076	77.52	30.035	80.48	29.949	83.93	29.869	87.25	29.869	88.54
15	30.123	75.16	30.082	77.07	30.031	81.29	29.960	83.88	29.866	87.43	29.862	89.19
16	30.095	75.54	30.069	77.39	30.014	81.80	29.951	83.55	29.876	86.65	29.859	87.57
17	30.105	75.27	30.069	77.93	30.008	80.84	29.930	84.44	29.862	86.82	29.853	88.16
18	30.104	76.16	30.027	77.77	30.010	81.14	29.931	84.46	29.876	86.87	29.858	88.88
19	30.091	76.17	30.068	77.92	30.007	81.34	29.934	84.40	29.870	87.13	29.855	88.19
20	30.116	75.91	30.004	78.98	30.002	81.54	29.926	84.09	29.863	86.92	29.865	88.29
21	30.091	76.22	30.075	78.97	30.000	81.47	29.917	84.43	29.839	87.83	29.872	87.26
22	30.102	76.67	30.051	78.85	29.994	81.85	29.933	84.39	29.848	87.34	29.874	87.13
23	30.092	77.27	30.082	79.13	29.997	81.82	29.927	83.73	29.848	87.72	29.879	87.33
24	30.081	76.91	30.071	79.15	30.000	81.57	29.944	85.59	29.846	88.99	29.878	86.93
25	30.079	77.18	30.070	78.75	29.996	82.35	29.946	85.06	29.855	87.97	29.886	86.57
26	30.074	76.75	30.071	78.50	30.004	82.67	29.940	85.36	29.850	87.78	29.889	86.57
27	30.106	77.40	30.077	78.31	30.003	83.77	29.926	85.42	29.830	88.32	29.886	86.50
28	30.073	76.52	30.065	78.97	29.992	81.37	29.929	85.15	29.833	88.51	29.879	87.10
29	30.097	77.14	30.072	78.36	29.983	81.57	29.924	85.25	29.839	88.37	29.877	86.43
30	30.099	76.86	—	—	29.965	82.27	29.906	85.58	29.848	87.99	29.864	86.58
31	30.100	77.38	—	—	29.973	82.44	—	—	29.833	87.51	—	—

the Barometer and Thermometer, as found by Observations taken between the
and 1822.

JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
Barom.	Ther.	Barom.	Ther.	Barom.	Ther.	Barom.	Ther.	Barom.	Ther.	Barom.	Ther.
Inches.	Deg.	Inches.	Deg.	Inches.	Deg.	Inches.	Deg.	Inches.	Deg.	Inches.	Deg.
29'847	86'91	29'891	84'43	29'892	85'53	29'950	83'18	29'996	80'76	30'063	77'20
29'843	86'57	29'881	84'51	29'891	85'19	29'940	82'93	29'994	79'74	30'068	77'90
29'839	86'90	29'892	84'85	29'879	85'17	29'939	82'82	29'994	79'93	30'056	77'65
29'863	86'58	29'893	84'45	29'876	85'30	29'934	83'20	29'999	80'33	30'068	77'17
29'854	86'75	29'893	84'58	29'881	85'56	29'936	83'10	29'998	80'23	30'059	77'15
29'857	86'05	29'894	84'28	29'897	84'41	29'945	83'05	29'993	79'73	30'051	77'66
29'839	85'81	29'879	84'33	29'886	84'33	29'947	83'00	29'992	80'15	30'051	76'92
29'846	86'70	29'871	84'60	29'877	84'55	29'957	82'41	29'994	79'51	30'063	77'38
29'845	85'97	29'862	84'48	29'896	84'61	29'946	82'58	30'004	78'54	30'077	77'37
29'855	85'86	29'870	85'00	29'895	84'09	29'957	82'75	30'004	78'46	30'053	76'86
29'844	85'11	29'870	84'73	29'901	83'50	29'978	82'82	30'000	79'02	30'063	76'72
29'842	85'52	29'876	85'21	29'900	83'21	29'984	83'15	29'998	78'52	30'087	76'36
29'854	85'82	29'878	85'55	29'898	84'04	29'962	81'79	30'003	78'95	30'076	75'83
29'850	85'59	29'874	84'84	29'900	82'95	29'951	82'35	30'018	79'32	30'077	76'11
29'853	84'99	29'871	83'72	29'898	84'09	29'958	82'39	30'030	79'02	30'090	75'83
29'851	84'99	29'882	84'94	29'899	84'17	29'958	82'16	30'032	79'07	30'090	76'20
29'856	84'75	29'879	84'20	29'900	83'78	29'965	81'66	30'033	77'38	30'087	76'19
29'854	85'11	29'889	84'16	29'911	83'11	29'967	81'78	30'039	78'88	30'091	75'93
29'862	84'97	29'875	83'82	29'909	82'61	29'958	82'09	30'050	79'07	30'104	75'72
29'861	84'96	29'885	83'33	29'913	82'63	29'946	80'55	30'050	79'02	30'099	75'92
29'833	84'64	29'871	83'78	29'911	82'67	29'980	81'67	30'057	79'23	30'095	75'24
29'864	84'12	29'867	84'53	29'911	83'17	29'930	81'95	30'066	79'25	30'098	75'37
29'866	84'74	29'878	84'73	29'924	82'89	29'986	82'04	30'062	79'56	30'105	75'14
29'864	85'24	29'885	84'16	29'924	83'11	29'966	80'30	30'060	78'92	30'105	74'72
29'867	84'62	29'890	85'26	29'917	83'44	29'974	81'53	30'038	78'68	30'113	75'91
29'870	85'06	29'897	84'33	29'920	83'03	30'003	80'73	30'040	78'49	30'114	75'79
29'865	85'06	29'892	84'87	29'920	83'56	29'986	80'72	30'053	78'14	30'107	75'92
29'873	84'94	29'890	85'15	29'939	83'27	29'985	80'96	30'061	78'66	30'118	76'28
29'879	85'07	29'883	84'87	29'944	83'66	29'995	81'10	30'079	78'73	30'112	76'37
29'871	84'75	29'899	85'74	29'939	83'14	30'002	79'58	30'089	78'48	30'102	76'38
29'879	84'17	29'891	83'84	—	—	30'001	79'94	—	—	30'112	76'08

The following Table shews the Mean Annual Heights of the Barometer and Thermometer at Madras, between the Years 1796 and 1821, with the General Mean of each.

YEAR.	BAROMETER.	THERMOMETER.
	Inches.	Deg.
1796	29·981	80·780
1797	29·948	83·430
1798	29·974	81·744
1799	29·988	81·430
1800	29·966	81·680
1801	29·966	81·354
1802	29·968	82·938
1803	30·006	82·571
1804	30·007	83·580
1805	30·067	82·046
1806	29·966	81·705
1807	29·923	79·738
1813	29·831	82·055
1814	29·891	81·304
1815	29·919	81·313
1816	29·972	80·434
1817	29·999	81·059
1818	29·950	81·088
1819	29·949	81·596
1820	29·950	81·546
1821	30·035	82·330
General Mean ..	29·964	81·700

The subjoined Table shews the Mean Monthly Heights of the Barometer and Thermometer, between the Years 1796 and 1821, with the Heights of the Hygrometer and the Mean Fall of Rain.

MONTHS.	Mean Monthly Height for 21 Years, between 1796 and 1821.		Hygrometer, between 1819 and 1823.	Mean Fall of Rain for 13 Years, between 1803 and 1821.	
	Barometer.	Thermometer.		Including the whole Fall during Storms.	Fall in Storms reduced to the Mean Fall.
	Inches.	Deg.	Dry.	Inches.	Inches.
January.....	30·085	75·168	13·0	0·608	0·608
February.....	30·076	77·157	17·5	0·127	0·127
March.....	30·041	79·920	17·5	0·538	0·538
April.....	29·955	82·417	18·0	0·384	0·384
May.....	29·851	86·918	20·9	1·419	0·121
June.....	29·861	88·159	28·9	0·646	0·746
July.....	29·867	85·645	28·6	3·303	3·303
August.....	29·879	84·732	18·8	3·552	3·552
September...	29·908	83·825	15·5	4·824	4·824
October.....	29·942	81·858	17·6	11·294	11·294
November....	29·956	78·672	7·9	14·803	14·803
December....	30·074	78·843	18·2	8·618	6·048
Mean....	29·958	81·693	18·5	50·124	46·348

We find upon examination of the first of the three Tables, that the hottest day at Madras, by the mean of all the daily observations during twenty-one years, is the 15th of June; when the mean height of the thermometer in the twenty-four hours is $89^{\circ}19$; the mean varying in different years from $95^{\circ}1$ to $81^{\circ}6$. The coldest day is the 9th of January; the mean height of the thermometer on that day being $74^{\circ}59$; and the mean varying from $77^{\circ}1$ to $71^{\circ}7$. About the 20th of March and the 20th of October the thermometer is at its mean height.

The mean height of the thermometer, as deduced from the mean monthly heights, is $81^{\circ}7$: the greatest extreme of heat was $104^{\circ}5$; the least height of the thermometer 64 ; the former occurred in the year 1815 at 2 P.M. on the 19th of May, a hot land wind blowing; and the latter on the 12th January 1819, at about sun-rise; such extremes, however, are rare, the thermometer at Madras being seldom higher than 98° or lower than 67° .

The hottest time of the twenty-four hours at Madras, taking the mean of the twelve months, is about three-quarters of an hour past noon ; this varies at different times of the year from 11 A.M. to 3 P.M. The coolest time of the twenty-four hours is about half an hour after four in the morning ; and the thermometer is usually at the mean height a little after seven in the evening, and about nine in the forenoon.

The following statement shews the average times of the greatest, least, and mean heat during each month ; and is formed from the diary in 1823 for every hour :

H E A T.

MONTHS.			GREATEST.	LEAST.	MEAN.	
			Afternoon. H.	Morning. H.	Evening. H.	Forenoon. H.
January	..	..	1.3	4.3	7.2	9.2
February	..	..	12.	5.3	7.2	8.8
March	..	..	12.3	5.0	7.4	8.7
April		..	12.	4.7	7.2	8.6
May	..	..	11.3 A.M.	4.1	6.4	8.5
June	..	..	2.	4.3	7.8	8.8
July	..	..	2.3	4.	6.6	9.6
August	..	..	2.	3.	7.5	8.9
September		..	2.	4.3	7.9	8.6
October	..	..	12.	4.8	6.7	8.7
November		..	12.3	5.7	6.4	8.8
December		..	12.7	5.3	8.6	9.5
Mean	..		12.8	4.6	7.2	8.9

According to the mean of the hygrometer during the year 1823, the atmosphere at Madras is least moist at about two o'clock in the afternoon ; is most moist at a quarter before six in the morning ; and is in a mean state at a quarter past nine at night, and a quarter past ten in the forenoon. The following abstract from the hourly diary in 1823, shews the average times when the atmosphere has the greatest, least, and mean moisture for each month :

ATMOSPHERE.

MONTHS.	MOST DRY.	LEAST DRY.	IN A MEAN STATE.	
	Afternoon. H.	Morning. H.	Night. H.	Forenoon. H.
January	1·5	6·	7·5	12·7
February	5·7	7·8	12·3	11·7
March	5·3	6·2	10·4	10·5
April	12·2	4·7	8·7	9·3
May	11·9	5·8	7·7	8·6
June	1·3	1·3	7·4	9·9
July	2·7	6·5	8·2	10·4
August	10·7	5·7	9·	10·6
September	1·7	5·3	9·9	10·
October	2·3	5·5	7·4	8·8
November	3·2	8·	10·3	11·3
December	3·	5·2	11·	10·4
Mean	2·1	5·7	9·2	10·3

The barometer is highest at Madras upon a mean of years on the 3d of January, and lowest about the end of May; the range being from 30,194 to 29,834 inches; but in the storms that have occurred of late years, the barometer was depressed in an extraordinary degree for that place, as I shall more particularly notice before I close these remarks.

The barometer is 0·142 inches higher, and the thermometer 7°·18 lower, in the N.E. monsoon than in the S.W., as will appear by the following statement:

Mean Height of the Thermometer and Barometer, during the N.E. and S.W. Monsoons, between 1796 and 1821.

N. E. Monsoon between 1796 and 1821.			S. W. Monsoon between 1796 and 1821.		
Months.	Thermometer.	Barometer.	Months.	Thermometer.	Barometer.
	Deg.	Inches.		Deg.	Inches.
October ..	81·858	29·942	April ..	82·417	29·955
November ..	78·672	29·956	May ..	86·918	29·851
December ..	75·843	30·074	June ..	88·159	29·861
January ..	75·168	30·085	July ..	85·645	29·867
February ..	77·157	30·076	August ..	84·732	29·879
March ..	79·920	30·041	September ..	83·825	29·908
Mean ..	78·103	30·029	Mean ..	85·283	29·887
				78·013	30·029
			Difference	7·180	0·142

WINDS AND WEATHER AT MADRAS.—The division of the winds dependent upon the place of the sun, is into the N.E. and S.W. monsoons. The N.E. monsoon, taking the mean of years, sets in on the 19th of October,* and ends about the 2d of March, heavy rains falling sometimes for several days together from its commencement to the middle of December, attended at times by gales of wind; after which, till the close of this monsoon, the air is generally clear and cool, and the weather pleasant. The mean fall of rain during the monsoon season, as this is termed, is about 33 or 34 inches. The fall in the year, as given in a foregoing statement, is 50·214 inches, including the fall during the storms which have occurred of late years; but only about 46·35 inches, if we reduce that fall to the fall of ordinary years. The statement just alluded to shewed the fall of rain for thirteen years; in the following, some years are added, making altogether eighteen years.

The following shews the mean monthly fall of rain at Madras, from the beginning of the year 1803 to the end of 1825, including the fall during the storms:

Mean Fall of each Month in 18 Years.						
						Inches.
January	..	..	..	..	..	0·737
February	..	..	..	..	..	0·099
March	..	..	..	..	..	0·469
April	..	..	..	..	..	0·333
May ..	..	..	..	..	..	1·354
June ..	..	..	..	..	..	0·854
July ..	..	..	..	..	..	2·945
August	..	..	..	..	..	3·883
September	..	..	..	..	..	4·359
October	..	..	..	..	..	12·273
November	..	..	..	..	..	13·937
December	..	..	..	..	..	7·522
Mean Fall annually						Inches 48·755

If the fall during the storms be allowed for, the yearly fall will be 46 inches, or about one-third of an inch less than that before given for thirteen years.

The south wind commences about the 2d of March, and blows along the shore, bringing with it a great degree of dampness, and having at the same time a sultriness, which, combined with the damp, make it much complained of; this wind blows, according to the average standard before-mentioned, till the 29th of April, when there are sometimes for a week or two land or S.W. and Westerly winds; and at other times South and South-easterly winds. The land wind sets in about the 16th of May, and continues blowing, and generally with a great degree of heat, during some weeks, cooled

* This agrees nearly with the usual practice, which is to lower the flag-staff of the Fort at Madras on the 15th of October, when the stormy season is considered to commence. It is hoisted again on the 15th December; after which it is supposed ships may approach the coast with safety.

at intervals, however, by showers; it afterwards prevails only in the night, and in the early part of the forenoon, when during the remainder of the day its place is supplied by the S.E. or sea breeze.

About a month or more before the change of the monsoon and commencement of the rains, the wind is variable, with calms and a sultry and oppressive state of the atmosphere.

I have given the average times of the commencement of the monsoons; but there are considerable variations in a stated period of years; in the interval under review, for example, the N.E. monsoon and rains set in one year as early as the 29th September; and another year as late as the beginning of November. The land wind also has commenced at one time as early as the end of April, and has kept off at another time till the beginning of June. Respecting the state of the atmosphere, the results of these meteorological observations shew it is not quite so clear and serene as is commonly supposed; the mean of twenty-six years, giving us during the sun's revolution, only one hundred and eighty clear days; the remainder of the year is made up of sixty-four days clear in some part of the twenty-four hours, and the other part cloudy or hazy: of ninety-six cloudy days, and twenty-five hazy; there are also during the year fifty-seven, on which rain falls; thirty-one, when there is a dew, and only eighteen with lightning.

The following statement, being the mean of the details of the weather in the diary for the foregoing period of twenty-six years, shews how this state of the atmosphere was divided among the different months. This was constructed from a great mass of detail:

MONTHS.	Clear.	Cloudy.	Hazy.	Clear, Hazy, Cloudy.	Rain.	Dew.	Lightning.
	Days.	Days.	Days.	Days.	Days.	Days.	Days.
January	20	6	1	4	1	7	—
February	24	1	1	2	—	9	—
March	27	1	—	3	—	7	—
April	24	2	1	3	1	2	2
May	19	4	2	6	2	—	4
June	8	11	2	9	6	—	3
July	6	13	5	7	8	.	2
August	8	12	3	8	7	—	2
September	9	10	4	7	7	—	3
October	11	12	3	5	10	2	2
November	11	13	2	4	9	2	—
December	13	11	1	6	6	2	—
Annually by the Mean	180	96	25	64	57	31	18

The climate of Madras is generally healthy, and the thermometer during the hot season, not higher than at most other parts of the coast, nor indeed so high as at some

places; the country is flat for miles, and the soil sandy. What was formerly a plain of sand, reaching from the sea several miles inland, is now covered with habitations (many of a superior order) and gardens; with one of the finest roads in the world running through it, a distance to St. Thomas's Mount of about nine miles, and some way on, to the new cantonment. Madras, like most other places in India, has been visited with that dreadful malady, the *cholera*, as it is termed; to which many, both Europeans and natives, have fallen victims.

GALES OF WIND AND STORMS.—Gales of wind at Madras usually occur only during the rainy season, between the 15th of October and the middle of December; the barometer seldom sinks much more than four-tenths of an inch, or stands lower than 29·45 inches. These gales begin rather to the westward of north along the shore, veer to the eastward, and increase in violence as they get round; this change of direction continues, the wind gradually abating, until it is at south, when it frequently falls almost calm. From what has been just stated, the necessity for ships in Madras roads getting under weigh immediately a gale commences is apparent; as when the wind has veered easterly, it is next to impossible to get sea-room, and the vessels must be driven on shore.

I shall proceed to give some particulars of gales occurring during the period comprised in the diary.

On the 27th of October 1797, the moon having just passed the first quarter, and being at her greatest distance from the earth, there was a violent gale of wind at Madras, somewhat resembling the storms of late years; it began from the northward in the night between the 26th and 27th, veered to the N.E., and in the morning blew with uncommon violence during three hours. About noon it suddenly shifted to the south, and was almost as violent as before—many old trees were torn up by the roots, and the leaves on the north side of those much exposed, were either blown off, or completely withered. The barometer began to fall at about noon on the 25th, and at 2 o'clock P.M. on the 27th had sunk to 29·465 from 30·005, or about 0·54 of an inch. This, though not so violent as the late storms, was no ordinary gale of wind.

On the 10th of December 1807, the moon half-way between the first quarter and full, and nearly at the greatest distance from the earth, there was a gale at Madras. It began in the evening from the north, and was attended with thunder, lightning, and rain; veering to the southward of east, and blowing with violence, it slackened gradually after noon, and at 13 P.M. the sky was again clear. The barometer fell about 0·4 of an inch; rain 3½ inches. On the night between the 29th and 30th of March 1820, a strong gale of wind occurred; the moon at the full, but nearly at her greatest distance from the earth. This gale commenced from N.E. and blew with great violence at times; contrary to the course of the monsoon gales, it veered to the North, N.W., and S.W. Still violent; but at the latter quarter it gradually slackened, and broke up at about 9 A.M. The barometer fell 0·40 of an inch, and was a little above 29·5 when at the greatest depression: about 6½ inches of rain fell. The ships left the roads in the evening; but some of the smaller craft were driven on shore, and others went down at

their anchors. Several ships and smaller vessels were lost along the coast during the gale, which appears to have been more violent to the northward than at Madras.

The storms we have had of late years at Madras resemble whirlwinds, blowing all round the compass (from particular points with incredible fury), and are generally confined to a space comparatively small in diameter. I shall also endeavour to give some of the leading features of these.

On the 2d of May 1811, a violent storm occurred at Madras; the moon had passed the first quarter on the 30th of April, and was full on the 8th of May, and was also at her greatest distance from the earth. This storm raged with great fury, and did considerable mischief: I was in England at the time, but it appears, from what I can collect, to have begun from the northward, and to have blown equally strong from the East, S.E. and South. I did not, however, find the details in the diary; the barometer also was so much out of order, that nothing can be correctly stated regarding the actual quantity of depression.* The fall of rain was about five inches and a-half. It appears from the notices published at the time, that early on the 1st of May the surf was observed to be unusually high, while thick clouds continued to gather during the day from the N.E.; and that by day-light on the second the wind blew very hard, accompanied by heavy rain. About noon it increased, and towards midnight had arrived at its greatest height, when it blew with incredible fury. A friend who was at the presidency at the time, and who had great reason to recollect this storm, informs me, that raging with the greatest fury, it destroyed every vessel in the roads, with the exception of three, a small Spanish ship, an American, and a French cartel ship. These stood out to sea, but the former was driven on shore near Covelong; ninety country vessels went down at their anchors, and all the rest were driven on shore, along with the Dover frigate and Chichester store-ship; the whole beach having been covered with wreck and dead bodies for two miles north and south of Madras. The papers stated that the storm was not felt at the distance of forty miles from Madras.

On the 24th of October 1818, a second violent storm occurred at Madras. The moon had passed the last quarter about two days, and was nearly at her greatest distance from the earth: the wind, which was a strong northerly gale early in the morning, before ten in the forenoon had increased to a storm. An awful pause of half an hour occurred about this time; after which it blew a complete hurricane from the south, with a fury never perhaps before experienced at Madras. Some of the oldest trees, which had resisted the former storm, were rooted up; and the largest branches of others were torn off by the force of the wind. In some trees of a tough description of wood, such branches were seen hanging down and twisted, having been whirled round and round by the fury of the storm. Such a scene of desolation was presented as had hardly been witnessed at Madras; numbers of native habitations were levelled, many of the larger buildings injured, and some lives lost: several ships and brigs were at anchor in the roads. All

* The depression shewn does not appear to have been two-tenths of an inch, and consequently the instrument had scarcely any action.

these got under weigh, but the latter were driven on shore, and one of the ships foundered; another was driven on shore to the northward, and a third rendered unseaworthy, while the others generally sustained great damage. The fall of rain was about five inches. The barometer had fallen between eight o'clock P.M. of the 23d and day-light of the 24th, nearly three-tenths of an inch, standing at about 29·5; but during the awful lull at 10 A.M. it was at 28·780 inches, a most extraordinary and terrific depression, such as I never before heard of at Madras: towards noon it had risen about half an inch, and at sun-set was at 29·65 inches.

On the 9th of May 1820, another storm occurred at Madras; the moon having been between the third quarter and new, but at her nearest approach to the earth; it commenced in the evening of the 8th, in a gale from the N.W., increasing and blowing very strong before morning, accompanied by torrents of rain. Violent gusts continued all day of the 9th, when the wind began to shift round to W. and S.W, blowing with greater violence, if possible, than before, and the rain still falling in torrents. Before noon on the 10th, the violence of the storm had subsided. This storm was of far longer duration than either of those that preceded it, but like them, accompanied by torrents of rain, and veering to different points of the compass. The damage on shore was great and distressing; very many lives were stated to have been lost by this awful visitation, at and in the vicinity of the presidency; most of the ships put to sea early, but great destruction took place among the smaller vessels: only one ship was lost: the tanks burst, and the rivers overflowed in all directions, to the great destruction of property. This storm appears to have had a wider range than the former. The barometer, which on the 8th in the forenoon was at 29·750 inches, had fallen at sun-rise on the 9th to 29·400 inches; by noon, on the same day, to 29·135 inches; and at 3 P.M. it was at 28·816 inches; and at 5 at 28·670 inches, lower even than during the former storm. By sun-rise, on the 10th, it had risen to 29·633 inches; and before noon, on that day, to the accustomed height of the time of the year. Between the 8th at night, and the 10th at sun-rise, about 16 inches of rain fell.

It may probably appear somewhat extraordinary to those who consider the moon as having great influence in gales and storms, that at the times above noticed she was always (with one exception only) in a part of her orbit, when I believe she is considered by those just alluded to, as having the least influence. In one gale only was the moon at full, having also been mostly at the greatest distance from the earth.

In four of the above instances the moon, upon a mean, passed the meridian at 30 degrees south of the zenith of Madras; in three instances she passed at six degrees south, and the remaining two within about a degree to the northward; and if one were inclined to draw any conclusion from the circumstances under which these gales and storms occurred, it might be, to ascribe to the moon a protecting power against such visitations, instead of aiding to produce them; having been generally far removed from the earth at the time, and not in that part of her course where, acting in combination with the sun, she might be supposed to have the greatest influence.

4th January 1830.
